

CLAIMS

- [1] A method of cleaning a drainpipe installed in a transit vessel, characterized by:
- through a fluid delivery line, connecting a cleaning fluid tank storing cleaning fluid with a downstream end of the drainpipe, and through a fluid drain line connecting the cleaning fluid tank with an upstream end of the drainpipe;
- thereafter running a cleaning process for cleaning inside the drainpipe by bringing the cleaning fluid tank, fluid delivery line, drainpipe, and fluid drain line internally to a predetermined negative pressure, and supplying cleaning fluid from the cleaning fluid tank to the downstream end of the drainpipe via the fluid delivery line, reverse-flushing the cleaning fluid through the drainpipe to circulate the cleaning fluid back to the cleaning fluid tank through the fluid drain line;
- while running the cleaning process, monitoring cleaning fluid pressure near the drainpipe by detecting the fluid pressure inside the fluid delivery line; and
- if the detected cleaning fluid pressure exceeds a predetermined pressure, running a cleaning fluid recovery process of stopping supply of cleaning fluid to the drainpipe, and opening a portion of the fluid drain line to the atmosphere to pass the cleaning fluid from the drainpipe through the supply line and recover the cleaning fluid into the cleaning fluid tank.
- [2] The drainpipe cleaning method set forth in claim 1, characterized in being rendered so that the cleaning process is restarted after the cleaning fluid recovery process has been run.
- [3] The drainpipe cleaning method set forth in claim 2, characterized in being rendered so that when the cleaning process is restarted following the cleaning fluid recovery process, if during the cleaning process the cleaning fluid pressure inside

the fluid delivery line exceeds the predetermined pressure, the cleaning fluid recovery process and cleaning restart process are run repeatedly, and once the number of cleaning-fluid-recovery-process run cycles reaches a predetermined count, all processes are terminated.

- [4] The drainpipe cleaning method set forth in any of claims 1 to 3, characterized in being rendered so that while the cleaning process is being run, the rate of cleaning fluid flow through the fluid delivery line is monitored by detecting the flow, and once the cleaning fluid flow reaches a predetermined flow rate, all processes are terminated.
- [5] The drainpipe cleaning method set forth in claim 4, characterized in being rendered so that following confirmation that the rate of cleaning fluid flow through the fluid delivery line has reached the predetermined flow rate, the passage of a predetermined time period is awaited before terminating all processes.
- [6] The drainpipe cleaning method set forth in claim 4 or 5, characterized in being rendered so that upon confirming that the rate of cleaning fluid flow through the fluid delivery line has reached the predetermined flow rate, the time elapsed since the start of the cleaning process started is checked, and when the elapsed time has exceeded a predetermined time period, all processes are terminated.
- [7] A drainpipe cleaning apparatus for cleaning a drainpipe installed in a transit vessel, characterized by being configured to comprise:
 - a cleaning fluid tank for storing cleaning fluid;
 - an evacuation means for exteriorly evacuating gas inside the cleaning fluid tank to bring the tank interior to a negative pressure;
 - a base pressure detector for detecting pressure inside the cleaning fluid tank;

a fluid delivery line connected at one end to the downstream end of the drainpipe;

a fluid delivery means connected to the cleaning fluid tank, for pressurizing the cleaning fluid within the tank to supply the cleaning fluid to the other end of the fluid delivery line;

a discharge valve provided on the fluid delivery line for opening and closing the conduit within the fluid delivery line;

a cleaning fluid return line connected at one end to the fluid delivery line between the drainpipe and discharge valve, and connected at the other end to the cleaning fluid tank;

a cleaning fluid return valve provided on the cleaning fluid return line for opening and closing the conduit inside the cleaning fluid return line;

a inlet-side pressure detector provided proximate to the one end of the fluid delivery line, for detecting cleaning fluid pressure within the conduit in the vicinity of the one end;

a fluid drain line connected at one end to the upstream end of the drainpipe;

a gas-liquid separation tank connected to the other end of the fluid drain line, for separating out gas within cleaning fluid recovered from the fluid drain line;

an exhaust line connected to the gas-liquid separation tank for exteriorly exhausting gas inside the gas-liquid separation tank, the exhaust line being provided with a release valve for opening and closing the conduit inside the exhaust line;

a circulation line connected at one end to the gas-liquid separation tank, and connected at the other end to the cleaning fluid tank, for circulating recovered cleaning fluid in the gas-liquid separation tank back to the cleaning fluid tank;

a gas recovery line connected at one end to the gas-liquid separation tank and connected at the other end to the cleaning fluid tank, for recovering into the cleaning fluid tank gas separated inside the gas-liquid separation tank;

a gas recovery valve provided on the gas recovery line for opening and closing the conduit inside the gas recovery line; and

a control device for controlling operation of the evacuation means, fluid delivery means, discharge valve, cleaning fluid return valve, release valve, and gas recovery valve; and characterized in that

said control device is configured such that

while running a cleaning process in which said control device

drives the evacuation means and fluid delivery means,

brings the interior of the cleaning fluid tank to a predetermined negative pressure by putting the discharge valve open, the cleaning fluid return valve closed, the release valve closed, and the gas recovery valve opened,

supplies cleaning fluid to the downstream end of the drainpipe, and reverse-flushes the cleaning fluid through the drainpipe to recover the cleaning fluid into the gas-liquid separation tank, and then

circulates the cleaning fluid to the cleaning fluid tank,

said control device monitors the pressure detected by the inlet-side pressure detector, and if the detected pressure exceeds a predetermined pressure,

said control device runs a cleaning fluid recovery process in which said control device

halts the fluid delivery means, and
by putting the discharge valve closed, the cleaning fluid return valve open, the gas recovery valve closed, and the release valve open, recovers into the cleaning fluid tank the cleaning fluid in the drainpipe, through the fluid delivery line and through cleaning fluid return line branching from the fluid delivery line.

[8] The drainpipe cleaning apparatus set forth in claim 7, characterized in being configured so that after running the cleaning fluid recovery process the control device restarts the cleaning process if the pressure detected by the base pressure detector is confirmed to have become a predetermined pressure.

[9] The drainpipe cleaning apparatus set forth in claim 8, characterized in being configured so that said control device additionally checks the number of cleaning-fluid-recovery-process run cycles, and when the run count has reached a predetermined count, said control device outputs an alarm and terminates all processes.

[10] The drainpipe cleaning apparatus according to any of claims 7 to 9, characterized by being configured:

to further comprise a flow rate detector provided in the fluid delivery line; and so that while running the cleaning process said control device monitors the cleaning fluid flow rate in the fluid delivery line detected by the flow rate detector, once the flow rate reaches a predetermined flow rate, said control device runs the cleaning fluid recovery process, and terminates all processes after running the cleaning fluid recovery process.

[11] The drainpipe cleaning apparatus set forth in claim 10, characterized by being configured so that after confirming that the rate of cleaning fluid flow through

the fluid delivery line has reached the predetermined flow rate, said control device awaits the passage of a predetermined time period, runs the cleaning fluid recovery process, and terminates all processes after running the cleaning fluid recovery process.

- [12] The drainpipe cleaning apparatus set forth in claim 10 or 11, characterized by being configured so that after confirming that the rate of cleaning fluid flow through the fluid delivery line as detected by the flow rate detector has reached the predetermined flow rate, said control device before running the cleaning fluid recovery process checks time elapsed since the start of the cleaning process, and when the elapsed time has exceeded a predetermined time period, said control device runs the cleaning fluid recovery process, and terminates all processes after running the cleaning fluid recovery process.